(1)

SET – IV

ANSWER KEY

Q 1	A	**Select the correct alternative**	
	(i)	(b) 1.67×10^{-27} kg, 931 M eV	(2)
	(ii)	(c) 63 %	(2)
	(iii)	(a) $E_y + E_Y - E_x$	(2)
	(iv)	(a) 0.511KeV	(2)
	(v)	(c) 50^o, 54 V	(2)
	(vi)	(c) 0.0482 A^o	(2)
Q 1	B	**Answer in one sentence**	
	(i)	Angle of scattering will be 180^0.	(1)
	(ii)	The minimum projectile energy required for a nuclear reaction to take place.	(1)
	(iii)	Particle in motion showing wave nature are called as matter waves	(1)
Q 1	C	**Fill in the blanks**	
	(i)	$\frac{M-A}{A}$	(1)
	(ii)	0.01 per second.	(1)
	(iii)	Nuclear fusion	(1)
	(iv)	endoergic	(1)
	(v)	diffraction	(1)
Q.2	**A**	**Attempt ANY ONE**	
	(i)	Alpha decay Beta decay Gamma decay Comparison of characteristics (any Two)	(2) (2) (2) (2)
	(ii)	Definition of binding energy and binding energy per nucleon Graph of B. E. /nucleon and Characteristics Definition of packing Fraction $p = \frac{M-A}{A}$	(2) (4) (2)
Q.2	**B**	**Attempt ANY ONE**	
	(i)	Explanation on experimental set up Size: momentum $\Delta P = F \Delta t$ $\therefore \Delta P = \frac{1}{4\pi\epsilon_0}\frac{2e.Ze}{b.v}$ $\theta \sim \frac{\Delta P}{P} = \frac{1}{4\pi\epsilon_0}\frac{2e.Ze}{b.v} \times \frac{1}{mv}$ $b = \frac{1}{4\pi\epsilon_0}\frac{2Ze^2}{mv^2}\frac{1}{\theta}$ $\therefore R = \frac{1}{4\pi\epsilon_0}\frac{2Ze^2}{mv^2}$	(2) (2) (2) (2)

2

	(ii)	Explanation of the law of successive disintegration --------- $\frac{dN_2}{dt} = \lambda_1 N_1 - \lambda_2 N_2 = \lambda_1\left[N_0 e^{-\lambda_1 t}\right] - \lambda_2 N_2$ --------- $N_2 e^{\lambda_2 t} = \frac{\lambda_1 N_0}{\lambda_2 - \lambda_1}\left[e^{(\lambda_2-\lambda_1)t} - 1\right]$ --------- $N_2 = \frac{\lambda_1 N_0}{\lambda_2 - \lambda_1}\left[e^{-\lambda_1 t} - e^{-\lambda_2 t}\right]$ ---------	(2) (2) (2) (2)
Q.2	**C**	**Attempt ANY ONE**	
	(i)	$\frac{N_0}{N} = e^{\lambda t}$ $\therefore \lambda t = \frac{0.693}{T} \times t = 2.303 \times \log\frac{10}{7}$ T = 11.325 years	(1) (2) (1)
	(ii)	$R = R_0 A^{1/3}$ = 5.57 fermi $V = \frac{4}{3}\pi R^3 = 723.5 \times 10^{-45}$ m^3.	(2) (2)
Q.3	**A**	**Attempt ANY ONE**	
	(i)	Diagram: 2 marks Construction: 2 marks Working: 4 marks	(2) (2) (4)
	(ii)	Nuclear reaction definition Explaining different types of nuclear reactions: 3 marks each.	(2) (6)
Q.3	**B**	**Attempt ANY ONE**	
	(i)	Conservation law of atomic number, atomic mass, linear and angular momentum, energy etc. stated and explained: 8 marks	(8)
	(ii)	Use of momentum conservation laws or momentum triangle seen Diagram of momentum conservation or momentum triangle Define $Q = E_y + E_Y - E_x$ Rest of the derivation leading to $Q = E_y\left(1 + \frac{m_y}{M_Y}\right) - E_x\left(1 - \frac{m_x}{M_Y}\right) - \frac{2}{M_Y}\sqrt{m_x m_y E_x E_y}\cos\theta$	(2) (2) (1) (3)
Q.3	**C**	**Attempt ANY ONE**	
	(i)	$Q = \left[(m_x + M_X) - (m_y + M_Y)\right]c^2$: or if masses are expressed in amu $Q = \left[(m_x + M_X) - (m_y + M_Y)\right] \times 931.5MeV$ Q=-11.373615MeV $E_{th} \cong -\frac{Q(M_X+m_x)}{M_X}$ $E_{th} = 14.432528MeV$	(1) (1) (1) (1)
	(ii)	Definition Properties, examples or energy released etc.	(2) (2)
Q.4	**A**	**Attempt ANY ONE**	
	(i)	Diagram of Coolidge tube for X-ray production Construction Coolidge tube Explanation of X-rays production Any four properties	(2) (2) (2) (2)
	(ii)	Compton effect explanation Diagram of scattering of electron	(2) (1)

3

			(1)
		Applying law of conservation of momentum Simplifying equations Obtaining $\Delta\lambda = \frac{h}{m_0 c}(1-\cos\theta)$	(2) (2)
Q.4	B	**Attempt ANY ONE**	
	(i)	Diagram of Davisson-Germer Experiment Construction Polar graph explanation to get λ Finding λ using Bragg's law	(2) (2) (2) (2)
	(ii)	Gravitational red shift explanation Considering the condition of a photon emitted by a star Condition of photon reaching the earth Deriving the expression $\frac{\Delta\nu}{\nu} = \frac{GM}{c^2R}$	(2) (2) (1) (3)
Q.4	C	**Attempt ANY ONE**	
	(i)	Given: $\lambda_i = 0.2\ A^o = 0.2\times10^{-10}$ m $\theta = 110^o$ Compton shift $= \Delta\lambda = \lambda_s - \lambda_i = \frac{h}{m_0 c}(1-\cos\theta) = 0.0325\ A^o$ $\lambda_s = 0.2325\ A^o$	(2) (2) (1)
	(ii)	Energy $eV = h\upsilon_K = \frac{hc}{\lambda_K}$ $V = \frac{hc}{e\lambda_K} = 93$ KV (putting the values and solving)	(3) (2)
Q 5		**Attempt ANY FOUR**	
	(i)	$1\ amu = \frac{1}{12}\left[\frac{12\times10^{-3}}{N_9}\right] = 1.6605\times10^{-27} kg$ Nuclear mass = $Z(M_P) + N(M_N)$ $E = mc^2$ $E = (1.66\times10^{-27})\times(3\times10^8)^2 = \frac{1.49\times10^{-10} eV}{1.6\times10^{-19}}$ 1 amu = 931 M eV ------	(1) (2) (1)
	(ii)	Explanation ${}^{14}_{7}N + {}^{1}_{0}n \rightarrow ({}^{15}_{7}N) \rightarrow {}^{14}_{6}C + {}^{1}_{1}H$ ------ ${}^{14}_{6}C \rightarrow {}^{14}_{7}N + \beta^- + antineutrino$ ------- $X = X_0 e^{-\lambda_C t}\quad \therefore t = \frac{1}{\lambda_C} ln\frac{X_0}{X}$	(2) (2)
	(iii)	$Q = [(m_x + M_X) - (m_y + M_Y)] \times 931.5 MeV$:1mark Q= -1.15506 MeV : 2 mark $E_{th} \cong -\frac{Q(M_X+m_x)}{M_X}$:1 mark $E_{th} = 1.485218 MeV$:1 mark	(1) (2) (1) (1)
	(iv)	$Q = [(m_x + M_X) - (m_y + M_Y)] \times 931.5 MeV$ As masses are expressed in amu Q=-2.9MeV Formula:2 mark Working: 2 marks Final answer with correct unit : 1 mark	(2) (2) (1)

	(v)	Thomson's Experiment setup with diagram and construction Observations and conclusions	(3) (2) (1)
	(vi)	$\Delta x_{max} = a$ Using HUP, $\Delta p_{min} = \frac{\hbar}{\Delta x}$ $\Delta p_{min} = h/a$ Minimum possible energy $E_{min} = \Delta p_{min}^2/2m = h^2/(2ma^2)$	(2) (2)